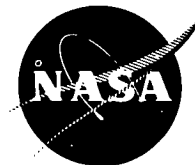


# NASA TECH BRIEF

## *Lewis Research Center*



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### Design Criteria Monograph on Turbopump Gears

A design criteria monograph has been published which is a summary and a systematic ordering of the large and loosely organized body of current techniques and practices for the successful design of liquid rocket engine turbopump gears.

This monograph was written to organize and present, for effective use in design, the significant experience and knowledge accumulated by NASA in development and operational programs. It reviews and assesses current design practices, and from them establishes firm guidance for achieving greater consistency in design, increased reliability in the end product, and greater efficiency in the design effort.

The unusual operating conditions for turbopump gears and the severe requirements imposed on them required advances in gear technology. Turbopump power gears were brought to acceptable levels of usefulness and reliability through refinements in interdependent areas of design, materials, processing, and quality control combined with extensive development testing that explored problem areas and evaluated potential solutions.

The development of gears for turbopumps required solutions in the following major problem areas:

(1) Tooth root fractures -- eliminated by a combination of modification of gear dimensions, improvement in material cleanliness, rigid control of manufacturing process, and shot peening.

(2) Compressive contact failures -- eliminated by improvement of gear geometry such as addendum proportioning, profile modification, and lead modification; improved material cleanliness; and rigid control of dimensions.

(3) Scoring in lubricated gears -- eliminated by control of surface texture, development of better lubricants, and advances in the design of lubricant delivery systems.

(4) Vibrational effects -- eliminated by modifying the magnitude or the frequency of exciting forces or by altering the response of the gear elements. Design variations for this purpose include changing the number of teeth, modifying the tooth profile, altering rim and web thicknesses, adding dampers, or reducing the allowable imbalance limits of the rotating members.

The monograph comprises two major sections: State of the Art, and Design Criteria and Recommended Practices. References complement the text.

The State of the Art section reviews and discusses the total design problem and identifies the design elements that are involved in successful design. The Design Criteria state clearly and briefly each rule, guide, limitation, or standard that must be imposed on each essential design element to assure successful design; the Recommended Practices set forth the best available procedures for satisfying the Design Criteria.

Both major sections are divided into five subject categories: Gear System, Gear Detail, Materials, Fabrication, and Testing.

This thorough review of design criteria and practices relating to turbopump gears should be of interest to manufacturers and users of power drives, turbine drives, and general rotary equipment.

#### Notes:

1. This monograph has been published as the following report:

NASA SP-8100 (N75-10166), Liquid Rocket Engine Turbopump Gears

Copies may be obtained at cost from:

Aerospace Research Applications Center  
Indiana University  
400 East Seventh Street  
Bloomington, Indiana 47401  
Telephone: 812-337-7833  
Reference: B75-10010

2. Specific technical questions may be directed to:  
Technology Utilization Officer  
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